APPENDIX B.9 LOWER WHITE SERVICE AREA
ELEMENT 1. SERVICE AREA DESCRIPTION

The Lower White Service Area (SA) is located in southeastern Indiana and is composed of the following three 8-digit HUC watersheds:

- 05120202 - Lower White
- 05120208 - Lower East Fork White
- 05120209 - Patoka

The Lower White SA includes all or portions of nineteen Indiana counties listed below and is located within the Southern Hills and Lowlands physiographic region.

Owen	Lawrence	Gibson
Sullivan	Knox	Pike
Greene	Daviess	Dubois
Monroe	Martin	Crawford
Brown	Washington	Warrick
Bartholomew	Orange	Spencer
Jackson		

Draining approximately 4,564 square miles of Indiana, the Lower White SA is located in both the Interior Plateau and Interior River Valleys and Hills ecoregions. The eastern half of the SA (Interior Plateau) is characterized by karst topography, containing a concentration of sinkhole areas as well as sinking stream basins in the south. The easternmost part of the Lower White SA is mostly forested and is distinguished by its narrow valleys and dissected high hills with silt loam soils. Moving west, sink holes and underground drainage dominate the area, especially within the Lower White Watershed, and the majority of soil here is leached; this area transitions to a more rugged, wooded area moving toward the western half of the SA (Interior River Valleys and Hills) (U.S. EPA: Ecoregions of Indiana).

The western half of the SA is characterized by lowlands formed in sedimentary rock, and till deposits which are common north of the White River. Valleys are widespread within the region, and some of the most distinguishing features are the historical and active mines in the southwest (U.S. EPA:

Ecoregions of Indiana). A number of large-scale wetland impacts have occurred near the surface mines in the Lower White SA bordering the Middle Wabash SA in addition to areas in the Patoka Watershed. Historically, a majority of mined land was abandoned without any restoration efforts; acid mine drainage degraded many aquatic systems in the past due to low pH to the point where the areas were devoid of local flora and fauna. The passing of the Surface Mining Control and Reclamation Act (SMCRA) by the United States government in 1977 has set strict reclamation rules for mining operations; the once degraded aquatic systems are now better able to support aquatic life with their improved water quality (Lower Patoka River WMP, 2008).

The Lower White SA contains many of Indiana's well-known aquatic systems including the White River (both the East Fork and West Fork), Monroe Lake, and the Patoka River. The East Fork of the White River enters the Lower White SA on the border of Washington and Jackson counties; both the East and West Forks of the White River travel southwest until their convergence at the Knox, Daviess, and Pike County borders; the White River joins with the Wabash River at the Indiana/Illinois border which eventually confluences with the Ohio River. Originating in the Hoosier National Forest, the Patoka River travels 138 miles westward and passes through one of Indiana's flood control reservoirs, Patoka Lake; the river confluences with the Wabash River in Gibson County. Formed from the forks of Salt Creek, Monroe Lake is Indiana's largest freshwater lake and is also one of Indiana's flood control reservoirs (USACE Louisville District, 2013).

Based on the 2011 NLCD, the land cover type with the most area in the Lower White SA is forest and scrub/shrub (48.3%), followed by agricultural land use (40.9%), developed and impervious land use (6%), and wetlands and open water (2.12%) (Homer, et al., 2015). Per the NWI, which accounts for more wetlands than does the 2011 NLCD, woody wetlands are the prominent wetland type covering approximately 2.42% of the SA, while emergent herbaceous wetlands cover 0.33%.

ELEMENT 2. THREATS TO AQUATIC RESOURCES

Aquatic resource threats specific to the Lower White SA have been identified using the same approach as the statewide portion of the CPF. The threats are presented in the order of the current predominance within the SA.

2.1 Section 404 Permitted Impacts

The Corps Section 404 permit data for impacts that required mitigation in the Lower White SA from 2009 – 2015 was collected and analyzed **(Table 91)**. According to the data, 271.5 acres of impacted wetlands and 946,429 linear feet of impacted streams required mitigation in the seven year time period. Locations of the permitted stream and wetland impacts are provided in **Figure 106**.

The energy production and mining work type account for the most stream impacts (76.8%), followed by transportation and service corridors (21.4%), development (0.79%), agricultural activities (0.67%), and dam and levee related activities (0.26%).

Energy production and mining accounted for the most wetland impacts (81.3%), followed by transportation (15.7%), agricultural activities (2.05%), development (0.78%), and dam and levee related activities (0.13%).

Work Type Category	Authorized Stream Impacts – Linear Feet	Percent of Stream Impact per Category	Authorized Wetland Impacts – Acres	Percent of Wetland Impact per Category
Agriculture	6,385	0.67%	5.556	2.05%
Dam	2,437	0.26%	0.345	0.13%
Development	7,516	0.79%	2.124	0.78%
Energy Production	727,212	76.84%	220.735	81.30%
Transportation	202,879.12	21.44%	42.739	15.74%
Grand Total	**946,429.12**	**100.00%**	**271.499**	**100.00%**

Table 91. Authorized 404 stream and wetland impacts requiring mitigation by work type category, 2009 – 2015
Source: USACE Louisville District.

Lower White Service Area

404 Permitted Aquatic Resource Impacts Requiring Mitigation

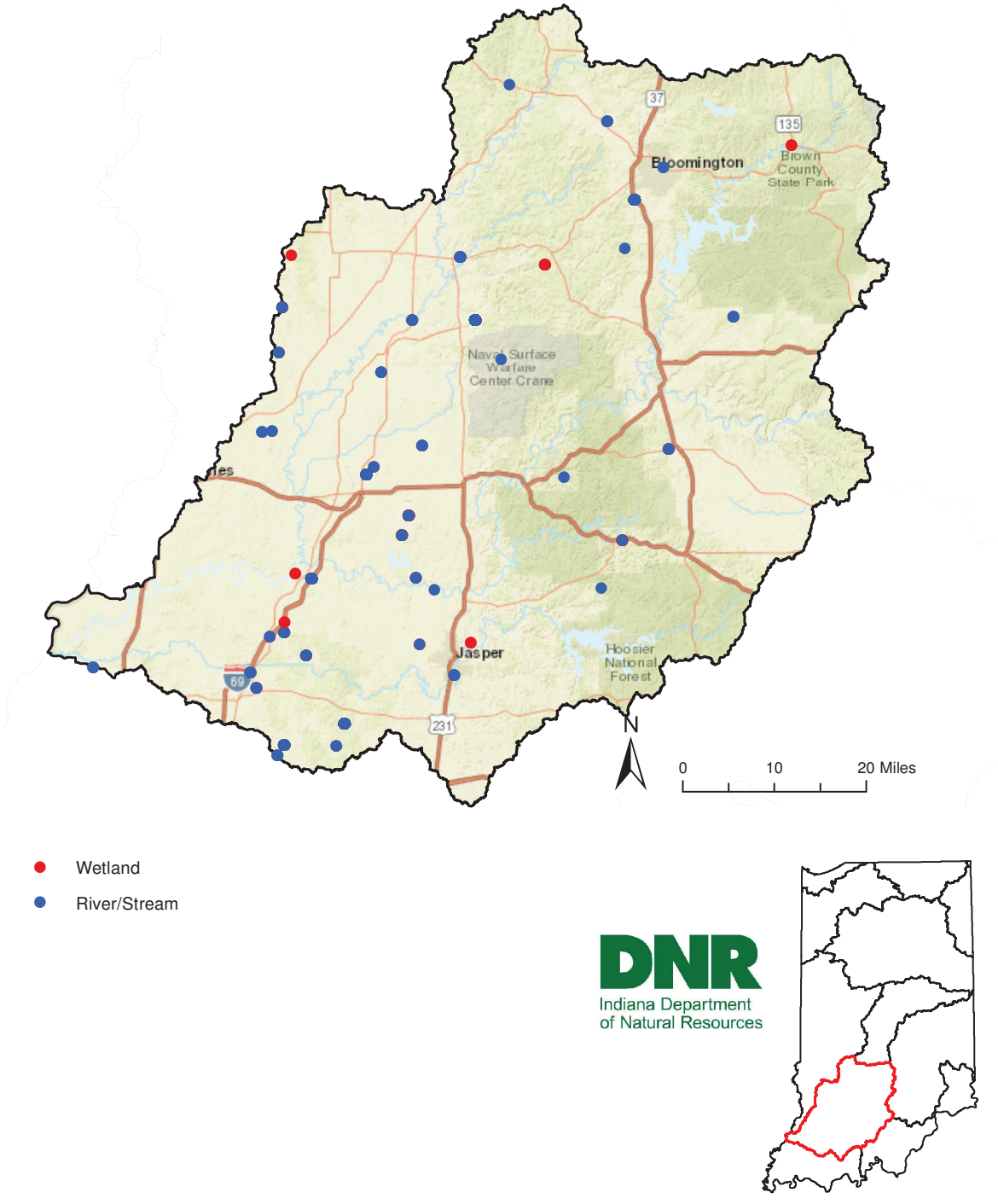

Figure 106. 404 permitted stream and wetland impacts requiring mitigation 2009- 2015

2.2 Land Cover and Land Use

In addition to 404 permitted work type categories, IDNR utilized the 2011 NLCD to identify land cover and land uses that contribute to aquatic resource and habitat impacts. Overall land cover within the Lower White SA is presented in **Figure 107,** and displays the geographical relationship of converted cover types relative to naturally occurring cover types.

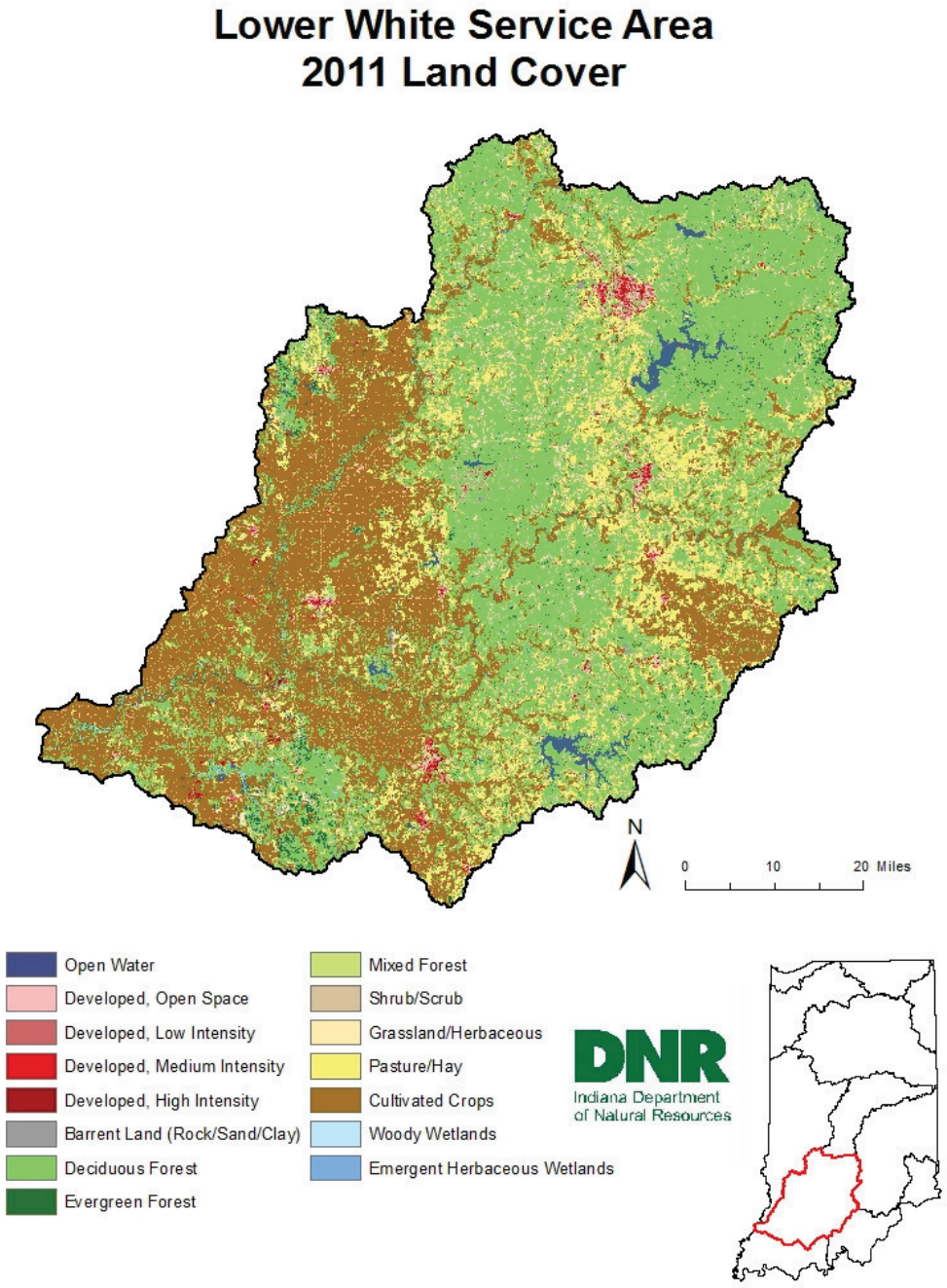

Figure 107. Land cover within the Upper Wabash Service Area from the 2011 NLCD (Homer, et al., 2015)

The land uses exhibited within the 2011 NLCD include multiple classes of cover, and some have additional values within specific classes based on variants or intensities within the classification **(Table 92)**.

Land Cover			
Class	**Value**	**Sum of Acres**	**Percent of Total Acres**
Open Water	*	53,096	1.82%
Developed	Open Space	135,010	4.62%
Developed	Low Intensity	24,643	0.84%
Developed	Medium Intensity	10,125	0.35%
Developed	High Intensity	4,520	0.15%
Barren Land (Rock/Sand Clay)	*	5,343	0.18%
Forest	Deciduous	1,372,249	46.98%
Forest	Evergreen	28,254	0.97%
Forest	Mixed	766	0.03%
Shrub/Scrub	*	9,471	0.32%
Grassland/Herbaceous	*	74,704	6.19%
Pasture/Hay (Agriculture)	*	328,884	11.26%
Cultivated Crops (Agriculture)	*	865,360	29.62%
Wetlands	Woody	4,330	0.15%
Wetlands	Emergent Herbaceous	4,311	0.15%
Grand Total		**2,921,066**	**100.00%**

Table 92. Lower White SA land cover classification/value percentages from 2011 National Land Cover Database
*** Class does not have additional values. (Homer, et al., 2015)**

IDNR combined the values within the same land cover classification in **Figure 108** below to demonstrate the current overall land cover distribution of the SA.

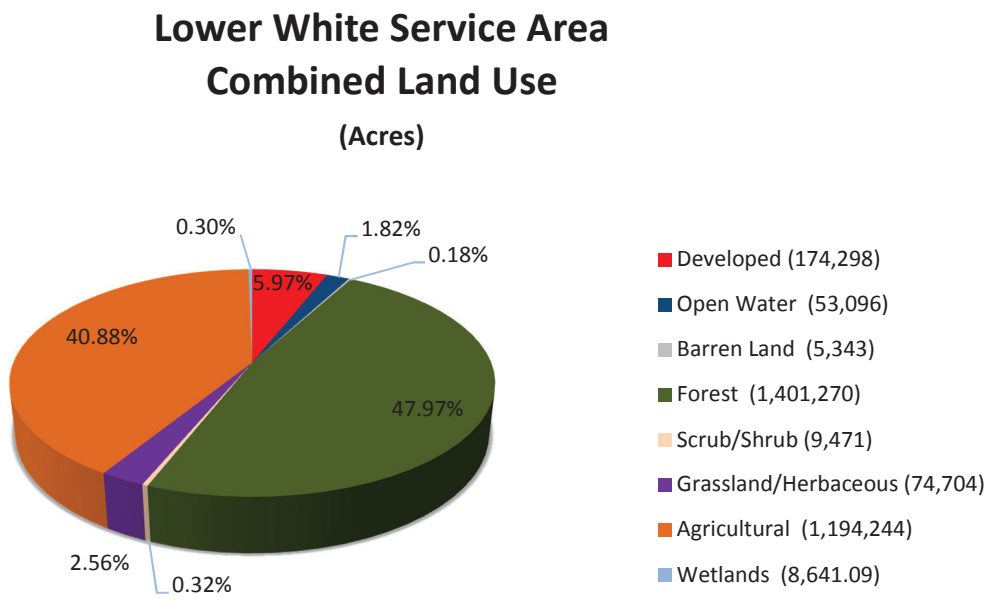

Figure 108. Combined land uses within the Lower White Service Area from the 2011 NLCD (Homer, et al., 2015)

2.3 Agricultural Land Use

Agricultural land use is the largest anthropogenic land use in the Lower White SA. Total agricultural land use covers approximately 41% of the SAs total land area of 1,194,244 acres (Homer, et al., 2015). Agricultural land uses are predominantly in the western portion of the SA.

Within the identified land use areas, cultivated crops cover over 865,365 acres (29.62%) and pasture/hay lands cover 328,884 acres (11.26%) of the SA (Homer, et al., 2015). Soybean production, followed closely by corn, is the primary cultivated crop based on USDA 2015 harvested crop production survey data from counties that comprise the majority of the Lower White SA (United States Department of Agriculture, 2016 and 2017).

Pasture/hay lands support livestock production for small to major livestock farming operations throughout the SA. The Lower White SA contains a multitude of large farming operations. The SA contains active turkey, pig, and chicken confined feeding operations (CFOs) which have a minimum of 5,000 animal units including two top producing counties that surpass the 15,000 animal unit threshold. The Lower White SA boundary contains the top turkey producing CFOs within the state. Dubois County has combined turkey CFOs surpassing 28,000 animal units making it easily the largest in the state (Thompson, 2008). When combining these major agricultural land use activities, the Lower White SA ranks fifth of total statewide agricultural land use (5.16%) and it is the most significant anthropogenic land use within the SA.

2.4 Growth and Development

Developed impervious land is the third largest land use after forested cover and agricultural land uses covering 174,298 acres (6%) of the 2,921,066 total acres, having the least developed footprint density of all SAs. The Lower White SA is the most rural of all SAs with agricultural land use and forest combining for approximately 89% of total cover. Communities with densely developed footprints include Bloomington, Bedford, Washington, Linton and Jasper, amongst many other smaller communities scattered across the SA.

The SA contains portions of the Indianapolis-Carmel-Anderson, Columbus, Terre Haute, Bloomington, Louisville-Jefferson County and Evansville MSA's, all of which experienced growth in the previous decade (Manns, 2013). Approximately 76.5% (390,984 acres) of the Bloomington MSA is within the SA which contains portions of Monroe and Owen Counties accounting for 13.4% of total SA acres.

Approximately 6.8% (189,119 acres) of the Indianapolis-Carmel-Anderson MSA is within the SA which contains the majority of Brown County and accounts for approximately 6.5% of total SA acres, though having less developed land cover than the remainder of this MSA to the north. The Terre Haute, Columbus and Evansville MSA's have small portions of them within this SA contributing minimally to the growth and development threat and combined only account for 0.9% (25,689 acres) of total SA acres.

Analysis of the INDOT cities and towns GIS data shows the Lower White SA contains all or part of 275 cities and/or towns, 48 of which are incorporated (INDOT, 2016).

Five Indiana regional councils that overlap the SA include the Southern Indiana Development Commission (44%), the Indiana 15 Regional Planning Commission (26%), the Economic Development Coalition of Southwest Indiana (4%), the River Hills Economic Development District & Regional Planning Commission (3%), and the West Central Indiana Economic Development District (1%) (IARC, 2017).

According to the SIDC 2015 CEDS, more workers commute out of this area for employment to the adjacent MSAs, though approximately 35% of workers in the region commute in from those same MSA's. Major industrial clusters are manufacturing, agri-business, food processing and technology, transportation and logistics, forest and wood products, chemical and chemical based products, biomedical and biotechnical, energy production and mining (fossil and renewable), defense and security, information technology and telecommunications, and glass and ceramics (SIDC, 2015).

According to the Indiana 15 Regional Planning Commission (2016), the leading industries in this region include forest and wood projects, agribusiness and food processing, manufacturing, mining, energy (fossil and renewable), apparel and textiles, chemicals and chemical based products, advanced materials, and transportation and logistics. Primary manufacturing clusters include primary metals, transportation equipment, fabricated metal products, and computer and electronics production. A

primary goal for this region is to attract new, and maintain existing, industry and business through support, industrial site expansions, and improvement of infrastructure (Indiana15RPC, 2016).

Additionally, analysis of INDOT's local roads GIS data shows there are approximately 9,790 miles of municipal and county roads contributing to the developed impervious land cover within the SA (INDOT Road Inventory Section, 2016). The Lower White SA ranks second to last among SAs in local road miles to square mile ratio at approximately 2.14 miles of local roads per square mile.

2.5 Transportation and Service Corridors

2.5.1 Roads

The Lower White SA contains approximately 1,189 miles of U.S. Interstates and highways, 2,232 miles of state highways, and 9.790 miles of local roads with in its boundary (INDOT Road Inventory Section, 2016). Although the Lower White SA is the fourth largest SA, the concentration of the various road types per square mile of land rank near the bottom.

U.S. Interstates and highways have a concentration of approximately 0.26 mile per square mile, which ties with the Ohio-Wabash Lowlands SA, ranking ninth among the eleven SAs. The concentration of state highways is approximately 0.49 mile per square mile, which ties with the St. Joseph River SA for the ranking of sixth, and is the highest ranking road type within the Lower White SA. The concentration of local roads is approximately 2.14 miles per square mile, which ranks tenth when compared to local roads rankings for the ten other SA. Similarly, the combined ranking of the concentration for all roadways, ranks at the bottom, with a concentration of 2.89 miles per square mile, which ranks eleventh overall.

2.5.2 Railroads

As an alternative mode of transportation, the Lower White SA has approximately 823 miles of railroad within the SA, which is the ninth largest concentration of railroads with a density of 0.18 mile per square mile (Federal Railroad Administration, 2002). Although active railroads rank near the bottom, they provide an important means of transportation for freight and passengers throughout the SA and state. The concentration of linear infrastructure throughout the SA contributes to aquatic resource threats that includes habitat fragmentation, disruption to fluvial processes, resource degradation, conversion and loss of aquatic resources.

2.5.3 Service Corridors

Similar to threats associated with roads and railroads, the Lower White SA contains service corridors that contribute to aquatic resource impacts and habitat loss associated with linear infrastructure. The SA contains over 3,024 miles of service corridors within its boundary.

The Lower White SA contains an extensive network of large kilovolt (kV) electric transmission lines within its boundary. The large kV transmission lines identified within the SA include approximately

thirty-eight (12 kV) lines, 117 (34.5 kV) lines, 205 (69 kV) lines, 104 (138 kV) lines, four (230 kV) lines, eighty-seven (345 kV) lines, and seven (765 kV) lines (Indiana Geological Survey, 2001). These lines extend over 1,444 miles throughout the SA, which is the third highest concentration of electric transmission lines relative to the SA size, with 0.53 mile of transmission line per square mile.

In addition to electric transmission lines, the Lower White SA contains over 1,580 miles of pipelines in total. It contains over 210 miles of pipelines that convey crude oil, 1,100 miles of pipelines that transport natural gas, and 270 miles of pipelines that deliver refined petroleum products (Indiana Geological Survey, 2002). When compared to the other SAs throughout the state, the Lower White SA contains the third greatest concentration of crude oil pipelines, fourth greatest concentration of natural gas and the sixth greatest concentration of refined petroleum product pipelines. While the Lower White SA is the fourth largest SA, similarly it ranks fourth for the total combined concentration of miles of pipelines when compared to all SA.

2.6 Dams and Non-Levee Embankments

There are currently 16 known low head dams (IDNR DOW, 2016) within the SA, ranking fourth in total number of dams among all SAs, although the SA has the third least concentration at one low head dam per 285 square miles. There are currently 200 state regulated high head dams (IDNR DOW, 2016) documented within the SA at a density of one dam per 23 square miles, the highest concentration of all SA's, containing 23% of documented high head dams statewide.

Per the NLE GIS analysis (IDNR, 2016), there are approximately 1,320,000 linear feet (250 miles) of NLE's mapped within the SA, averaging one mile of NLE per 18 square miles, tied for third highest concentration among all SAs. Approximately 151 miles of the NLE's are located within predominantly developed areas, the remaining 99 miles mapped in rural agricultural settings.

2.7 Energy Production and Mining

2.7.1 Coal

The Lower White SA contains historic and active coal mining operations within its boundary. Based upon the IDNR-Division of Reclamation (DOR) surface and underground coal mining dataset, coal mining operations were first recorded in 1848 and have effected over 210,000 acres (Gray, Ault, Keller, & Harper, Surface Coal Mines in Indiana, 2010); (Gray, Ault, Keller, & Harper, Underground Coal Mines in Indiana, 2010). Further analysis of surface and underground mining data, operation footprints and permitting history provides insight into coal mining lineage within the SA.

Mining operations, prior to the enactment of the SMRCA of 1977, were not required to implement post mining reclamation. The Lower White SA contained approximately 515 surface coal mines, approximately 57,924 acres, and 818 underground coal mines, approximately 36,844 acres of Pre-SMCRA coal mining operations. These Pre-SMCRA surface mining operations impacted 1.98% of the SA

land cover, which ranks second of the three coal bearing SAs. Pre-SMRCA underground mining operations impacted 1.26% of the SA land cover, which ranks last.

Surface and underground mining operations that fall under regulation of the SMRCA of 1977 are prevalent throughout the SA. The IDNR-DOR has recorded over 699 surface coal mining operations, which total approximately 82,468 acres and over 77 underground mining operations that total approximately 33,016 acres throughout the Lower White SA. These surface mining operations impact over 2.82% of the SA land cover, which ranks it first among the three SAs with coal resources. Similarly, the concentration of underground mining operations ranks first, with 1.13% SA land cover concentration.

Cumulative impacts from coal mining operations have resulted in the alteration of the SA. The Lower White SA is the second largest SA that contains coal with approximately 2,921,056 acres and it has experienced extensive impacts as a result of these activites. Surface mining has resulted in impacts to approximately 140,392 acres, altering over 4.81% of the SAs land cover which ranks it second amongst the coal-mined SAs. Similarly, underground mining impacts have altered over 69,861 acres of the Lower White SA, which ranks last with a concentration of 2.39% of the SA land cover.

2.7.2 Natural Gas and Oil Production

The Lower White SA contains a multitude of active oil and gas fields along with associated wells that support, or have supported, the petroleum industry within its boundary. The Indiana Geological Survey (IGS) identifies 79 petroleum gas fields with 237 associated gas wells; 68 oil fields with 1,754 oil wells; and 60 oil & gas fields with 28 oil & gas wells within the SA ranking the Lower White SA second statewide for active natural gas and oil fields (Indiana Geological Survey , 2015).

The Lower White SA, also contains a series of wells that are supplemental to, or associated with, the petroleum industry as identified within the IGS statewide well dataset. The IGS petroleum well data identifies 442 abandoned gas wells, 3,505 abandoned oil wells, 25 abandoned oil & gas wells, 7,724 dry wells, 101 observation wells, 751 stratigraphic wells, 76 saltwater disposal wells, 108 abandon saltwater disposal wells, 159 temporarily abandoned wells, 10 potable water supply wells, 12 non-potable water supply wells, 408 water injection wells, 330 gas storage, 35 abandoned gas storage, 13 abandoned observation wells, 234 abandoned water injection, 332 abandoned oil and water injection, one gas and water injection well, one abandoned oil & gas and water injection well, and one potable water supply well within the SA (Indiana Geological Survey, 2015).

2.7.3 Mineral Mining and Aggregates

The Lower White SA contains active mineral mining operations that extract and produce aggregate commodities. Based on the Indiana Geological Survey (IGS) 2016 active Indiana industrial mineral production data, the service area contains two sand & gravel mining operations, three clay and shale mining operations, 14 crushed stone operations, two dimensional sandstone quarry operations, 14

dimensional limestone quarries, and one gypsum mining operation (Indiana Geological Survey, 2016). In addition to the extraction of raw material aggregates, the SA includes one cement operation, which is an industry byproducts commodity that is used as aggregate (Indiana Geological Survey, 2016). In addition to the Lower White SA ranking fourth based on its size, mineral mining within its boundary ranks fourth in the state with 37 active operations.

2.8 Indiana State Wildlife Action Plan (SWAP) Identified Threats Anticipated Threats

The Lower White SA partially contains the Indiana SWAP Interior Plateau Planning Region (61.5%) as well as the Valleys and Hills Planning Region (38.5%). The SWAP identifies the most significant threats to habitats and SGCN overlapping these planning regions as:

- Habitat conversion, fragmentation and loss
- Natural systems modification
- Invasive species
- Dams
- Fish passage
- Point and non-point source pollution
- Water management and use
- Housing and urban areas
- Commercial and industrial areas
- Agriculture, aquaculture, livestock
- Roads and service corridors
- Changing frequency, duration, and intensity of drought and floods

These SWAP planning regions have experienced loss in the majority of habitat types over the last decade mostly to urban development (SWAP, 2015).

2.9 Anticipated Threats

The existing land uses within the developed impervious and agricultural footprints make up approximately 46.8% of the land use within the SA and are expected to remain as the top contributors to aquatic resource impairments.

IDNR expects energy production and mining, specifically surface coal mining, to remain the foremost permitted activity requiring mitigation for aquatic resource impacts, followed by transportation and service corridors, and development projects if the 404 permitting trends of the past 7 years continue.

Abandoned mines will continue to negatively impact the chemical, physical and biological integrity of aquatic resources. Among the many impacts to aquatic resource functions and services in this SA, invasive species will also continue to thrive unless restoration and enhancement efforts are increased and ongoing long term management activities are conducted.

Forests cover approximately 48% of the SA, so conversions of forest (deforestation) and timber harvesting have the potential to impact aquatic resources, though modern selective timber harvesting practices have moderated the industries' threat to aquatic resources.

According to the SIDC 2015 CEDS, this region experienced a slight gain in population of approximately 0.4% from 2000 to 2013. The region's population is expected to remain relatively the same through 2040, though Daviess County is expected to grow up to 23.5%, where the remainder of the counties are expected to decline in population. Agricultural drainage issues are also a concern in rural communities resulting in the management of water flow, soil erosion and sediment transport, construction runoff, and aging and failing septic systems. Economic development goals for this region include improved and expanded transportation, storm and waste water improvements, and utility infrastructure to attract residential, industrial, and commercial development. Crane Naval Surface Warfare Center is another major employer of the region contributing to growth and development in both the defense and security, and government service sectors (SIDC, 2015).

2.10 Offsets to Threats

IDNR will apply the same restoration, enhancement and/or preservation approaches to offsetting the predominant threats in the Lower White SA that were stated in the statewide portion of the CPF. The SA goals and objectives further define the general types and locations of the aquatic resources IDNR will provide as compensatory mitigation based upon identified threats, historic loss and current conditions. See **Appendix C** for a summary of offsets per major anthropogenic category and a general matrix of offset measures for each of the predominant threats to aquatic resources throughout the SA and the state.

ELEMENT 3. HISTORIC AQUATIC RESOURCE LOSS

The Lower White SA's historic aquatic resources were shaped by the drainages of the lower stretches of both the East and West Forks of the White River as they flow southwest to their confluence with the Wabash River. This includes the rugged topography and bedrock hills of unglaciated south-central Indiana with areas of karst topography. The western region of the SA transitions to the broad level plains of the Wabash River lowlands. The southern boundary of the SA contains the Patoka River as it flows west to its confluence with the Wabash River. The Lower White SA's historic aquatic resources were predominantly comprised of forested communities. The composition of the SA forests, wetlands and river and stream systems were shaped by these three river systems. However, the regions aquatic and natural communities were permanently altered by major land-use changes and conversions by early European settlement.

Agriculture within the Lower White SA has dominated the landscape and resulted in aquatic resource conversion and loss. The southwestern region of the SA is within close proximity to Vincennes, which is one of the earliest settlements within Indiana dating back to the 1700's. The proximity to this early settlement and the convergence of all of these rivers resulted in Europeans establishing settlements within the region. Agriculture has been the dominant land use in the region since early European settlement, which began by clearing forests for farming during the late 1700's, and over 150,000 acres in farmland by 1877 (Knox County Soil and Water Conservation District, 2007). Prior to the late

eighteenth century establishment of towns such as Monroe City in 1856 and Wheatland in 1858, the watershed consisted of upland forests, lowland forests and an extensive amount of wetlands and ponds (Knox County Soil and Water Conservation District, 2007).

By the late 1800s, there was a push to increase farm lands resulting in further alterations to, and loss of, aquatic resources. Broad creek and river bottomlands were opened up to agriculture during the 1880s due to the dredging and channelization of streams in order to drain malarial swamps (Knox County Soil and Water Conservation District, 2007). Similar efforts to channelize streams and drain wetlands was a common practice throughout the SA. Within the northwestern portion of the SA, in southwestern Greene County, the Goose Pond area's aquatic resources were altered by agriculture. Based on early surveys conducted around 1815, this area was comprised of marsh, prairie, forests and brushy ponds; however, the area experienced extensive ditching and draining for agriculture during the late 1800s (Indiana University-Purdue University Indianapolis, 2017).

The Lower White SA has an extensive history of surface and underground mining. Coal mining began in the early nineteenth century and underground mining became the predominant recovery method. Coal was first discovered in Pike County, located along the southern boundary of the Lower White SA, in 1860 and became a major industry to the area (Lower Patoka River WMP, 2008). The development of coal mines during this period became important to the establishment of settlements, towns and industries throughout the SA. The first underground coal mine established in Greene County in 1859, located near the northern boundary of the SA, and led to over 200 active mines within this county (Ksander, 2009). During the late 1800s, the Greene County region experienced an economic boom due to coal mining.

The relationship between transportation and coal became dependent on one another during this period. Trains required coal to power their engines and coal mines needed trains in order to transport the product to the national manufacturing market. In 1869, the Indianapolis and Vincennes Railroads established rail lines across Greene County, which accelerated mining throughout the region (Ksander, The Golden Age of Coal in Greene County, 2009). This network of railroads led to the explosion of urban settlements that supported mining and its associated industries. By the early 1900s, many of the smaller mines throughout the area had been abandoned or consolidated into larger coal companies such as Peabody Coal Company and Fourth Vein (Ksander, Beyond Boom and Bust...Coal's Human Toll, 2009). Throughout the following century the rise of surface coal mines became the predominant method of coal extraction.

Due to extensive aquatic resource loss within the Lower White SA, the understanding of the regions aquatic resources and the natural communities in which they existed is best reconstructed by evaluating the identified Natural Regions and Sections, and their related natural aquatic communities, associated within each respective Region and Section. **Figure 109** depicts each Natural Region and

Section, located within the Lower White SA, and identified within the Natural Regions of Indiana journal. In addition to the natural communities, the utilization of studies on Indiana's historic vegetative cover and mapped hydric and partially hydric soils provide further insight into the general location and makeup of the historic aquatic resources that existed before early European settlement initiated their prolonged loss **(Table 93)**. The table details the SA's estimated land cover percentages for each region and section, identified natural communities, estimated hydric and partially hydric soils, and estimated forest cover.

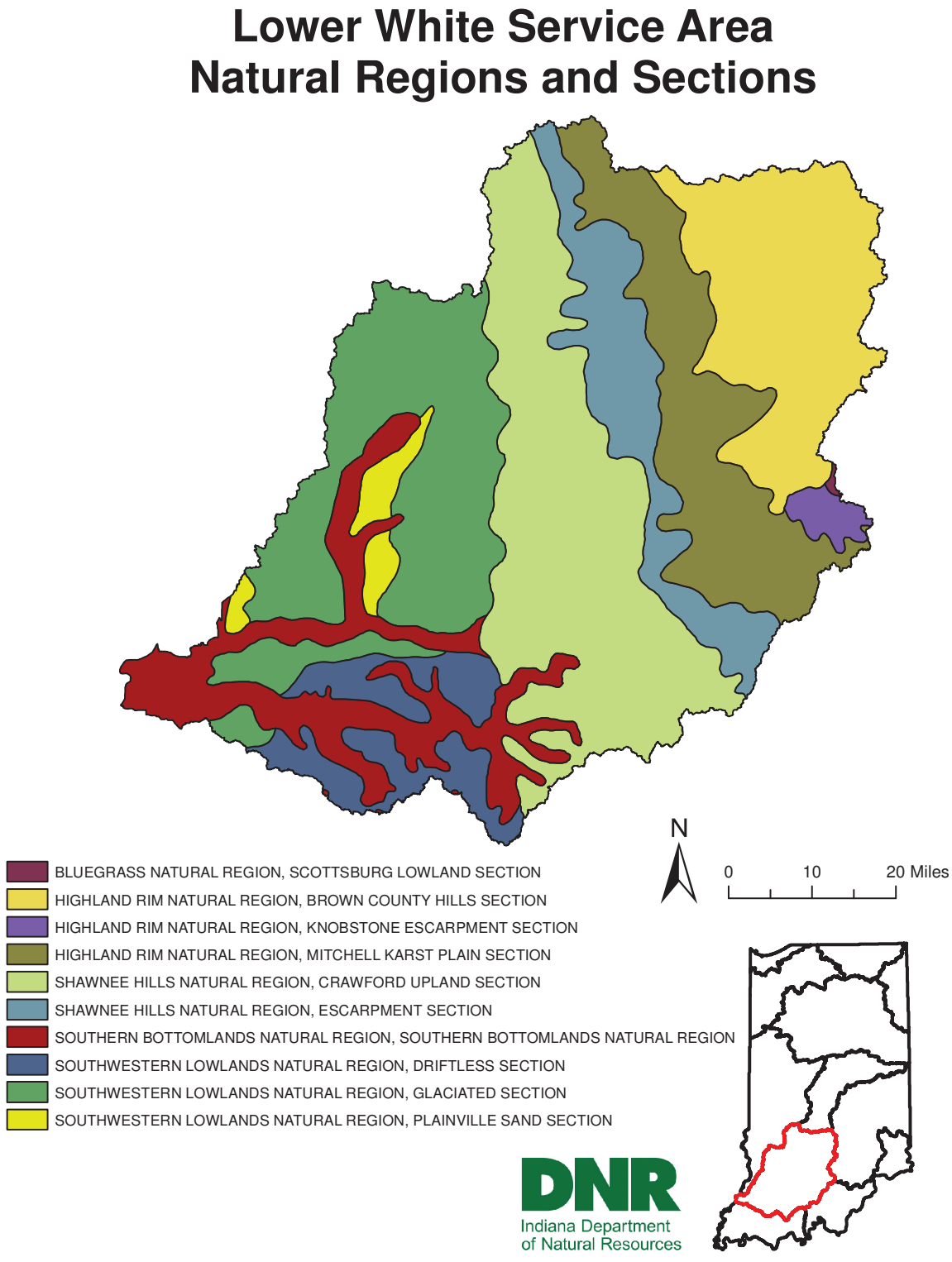

Figure 109. The natural regions and sections within the Lower White Service Area (Homoya, Abrell, Aldrich, & Post, 1985)

Natural Region(s)	Natural Region: Section(s)		Natural Region Community Types	Hydric Soils		Partially Hydric		Pre-Settlement % Forest Cover
	Name	% Cover		Acres	% Cover	Acres	% Cover	% Forested
Highland Rim	Brown County Hills	14.79	Predominantly forested upland oak-hickory, mesic ravines;, acid seep spring (rare); medium to low-gradient streams	188,583	6.46	15,533	0.53	99.9
	Mitchell Karst Plain	13.1	Predominantly forested, barrens, cave, karst sinkhole pond and swamp (southern, sinkhole), flatwoods, barrens, limestone glade and several upland forest types; medium and high-gradient streams with rocky bottoms (few surface in karst)					
	Knobstone Escarpment	1.04	Predominantly various forest communities, glades (rare); small, and ephemeral high-gradient streams					
South-western Lowlands	Plainville Sand	1.97	Predominantly barrens (ridges and well drained), swamp, marsh, and wet prairie swales					
	Glaciated	18.56	Predominantly forested, flatwoods, prairie (several), swamp, marsh, pond; low-gradient streams					
	Driftless	6.04	Predominantly upland forest, southern flatwoods, barrens (xeric, ephemerally wet), acid seep spring (rare), marsh, swamp, sandstone cliff; low to medium-gradient stream					
Shawnee Hills	Escarpment	8.76	Various upland forest types (dry-mesic and mesic); aquatic features include normally clear, medium and high-gradient streams, springs, and sinkhole ponds					
	Crawford Upland	24.15	Upland forest types, few sandstone and limestone glades, gravel washes, and barrens; acid seep spring community (rare)					
Bluegrass	Scottsburg Lowland	0.06	Predominantly floodplain forest and swamp; wetland, swamps, acid seep springs, pond; low-gradient, silty-bottomed streams and rivers					
Southern Bottomlands	Southern Bottomlands	11.52	Bottomland forest, swamp, pond, slough, and formerly marsh and prairie					

Table 93. The historic natural community composition for the Lower White Service Area based upon the natural region and section

ELEMENT 4. CURRENT AQUATIC RESOURCE CONDITIONS

4.1 Streams and Rivers

GIS analysis of 303(d) category 4A and 5 impaired streams (IDEM-IR, 2016) indicates there are currently 1,389 miles of category 4A impaired streams and 3,298 miles of category 5 impaired streams documented in the SA. IDEM reported E. coli (2,779 miles), impaired biotic communities (866 miles), PCBs in fish tissue (538 miles), nutrients (152 miles), dissolved oxygen (301 miles), total mercury in fish tissue (45 miles), and pH (6 miles) as current stream impairments within the SA (IDEM-IR, 2016). There are stream reaches in which multiple impairments may occur; therefore there is some overlap with the impaired stream miles.

As of 2014, IDEM conducted 564 QHEI assessment reaches within the SA **(Table 94 and Figure 110)** (IDEM OWQ, 2014). Of the stream and river habitat reaches assessed, 25.89% are capable of supporting a balanced warm water community.

QHEI Score Ranges	Narrative Rating	Count	Percent of Total
<51	Poor Habitat	239	42.38
51-64	Habitat is partially supportive of a stream's aquatic life design	179	31.74
>64	Habitat is capable of supporting a balanced warm water community	146	25.89
	Total	**564**	**100%**

Table 94. IDEM Overall QHEI scores for Lower White SA, 1991 – 2014 (IDEM OWQ, 2014)

As discussed in the statewide portion of the CPF, the functions and services provided by forests are important to the ecological health of aquatic resources in all portions of the SA that were historically forested. Analysis of the 2011 NLCD indicates that the Lower White SA ranks second overall in forested cover density of all SAs at 48% of total area with approximately 1,401,269 acres, and is the SA with the highest percentage of forested cover with approximately 26.9of 5,215,169 acres of forest cover statewide.

GIS analysis identified approximately 9,248,485 linear feet (1,752 miles) of stream located within 100 feet of agricultural fields. Under these criteria, the Lower White SA ranks fifth most in the ratio of these potentially restorable stream miles to square miles of SA at approximately 0.38 mile of potential restoration per one square mile, or one mile of potential restoration for every 2.61 square miles of SA.

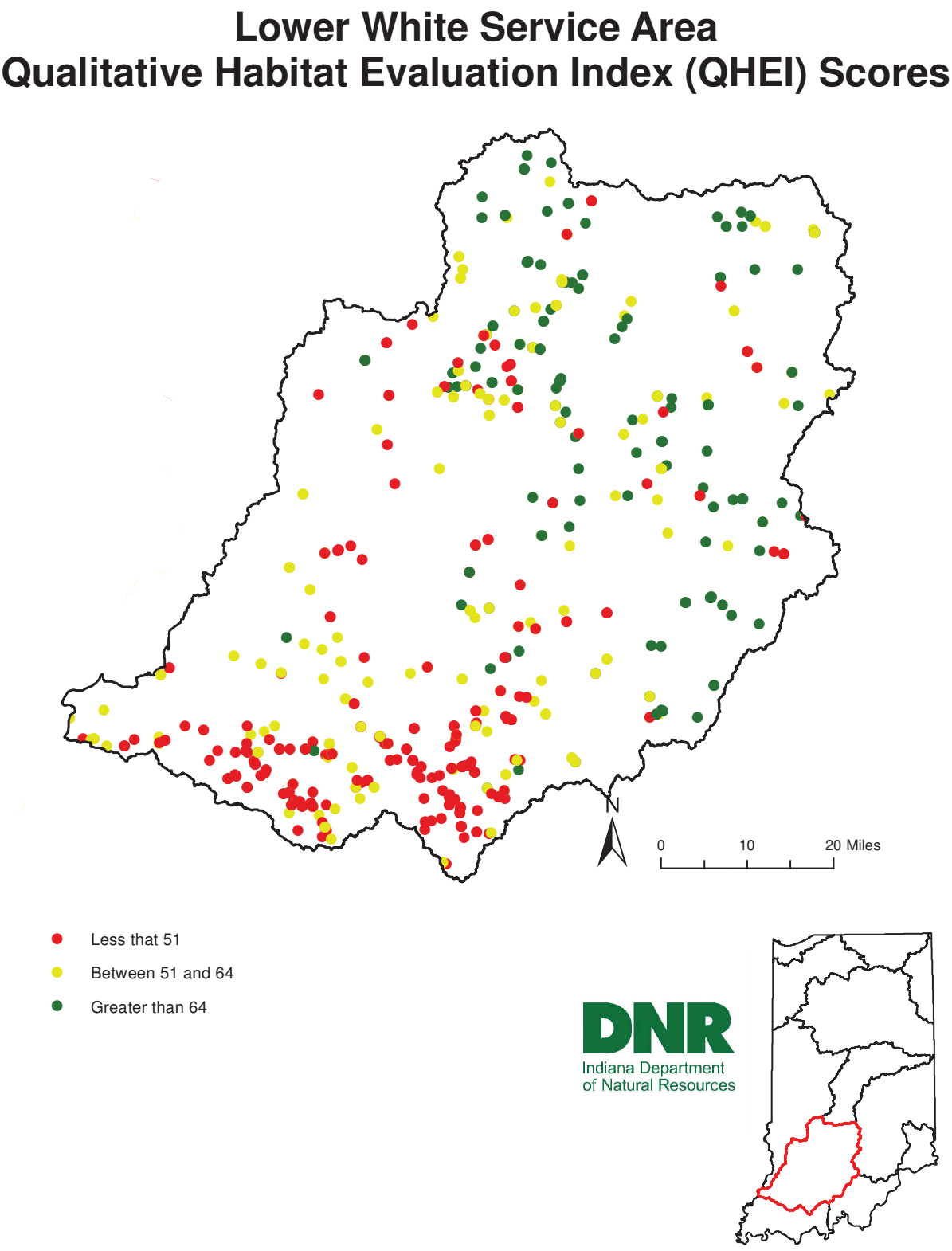

Figure 110. **IDEM overall QHEI scores within the Lower White service area; 1991-2014 (IDEM OWQ, 2014)**

4.2 Wetlands

Analysis of the NWI in the Lower White SA shows that there are approximately 9,495 acres of freshwater emergent wetland (PEM) and approximately 70,609 acres of combined freshwater forested (PFO) and scrub-shrub (PSS) wetlands, accounting for approximately 2.74% of the total SA acreage. All of the aquatic resource types from the NWI combined account for approximately 6.31% of the total SA **(Table 95 and Figure 111)**. Wetlands are greatest in the western portion of the SA in the Interior River Valleys and Hills ecoregion (The Status of Wetlands in Indiana: IDNR, 1996).

Aquatic Resource Type	Sum of NWI Aquatic Resource ACRES in SA	Percent of Total NWI Aquatic Resource Acres in SA	Percent of SA Total Acres	Percent of Total State Area –Acres
Freshwater Emergent Wetland	9,495	5.16%	0.33%	0.04%
Freshwater Forested/Shrub Wetland	70,609	38.38%	2.42%	0.31%
Freshwater Pond	25,543	13.88%	0.87%	0.11%
Lake	30,544	16.60%	1.05%	0.13%
Riverine	47,780	25.97%	1.64%	0.21%
Grand Total	**183,971**	**100.00%**	**6.29%**	**0.80%**

Table 95. Acres and percentage of acres of aquatic resource types from NWI analysis (USFWS NWI, 2015)

Hydric and partially hydric soils account for 157,833 acres (**Figure 112**), or 5.4% land cover within the SA, out of which approximately 94,500 acres have the potential to be restored, accounting for 3.24% of the total SA. This was determined by mapping current hydric and partially hydric soils data with potentially restorable land cover types (e.g., cropland, pasture), excluding PFO, PSS and PEM wetlands from the NWI within agricultural land use. The Lower White SA has the second to least percentage of recoverable wetland acres to total SA size of all SAs, and the fourth least potentially restorable wetland acres of any SA.

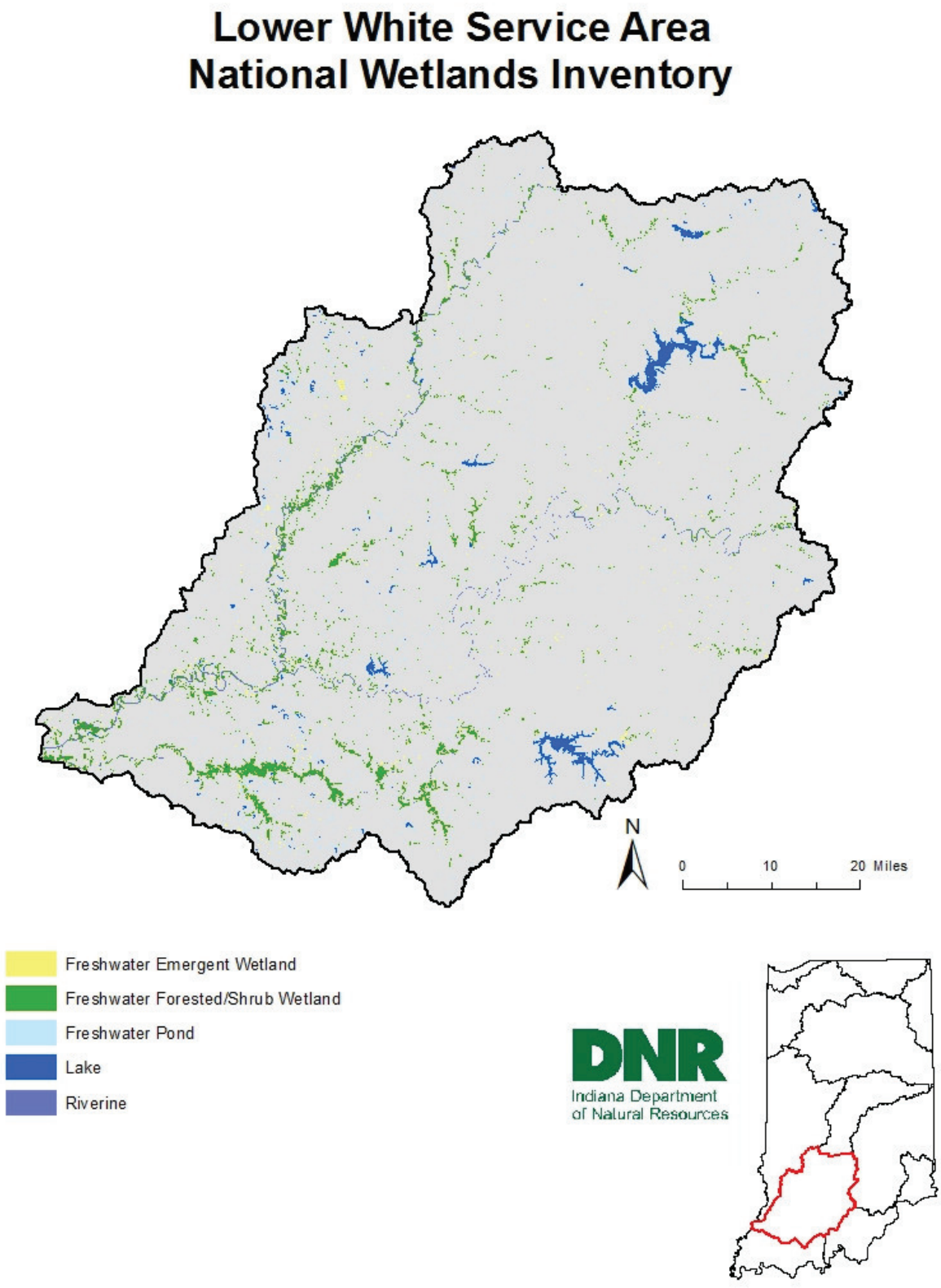

Figure 111. NWI for the Lower White Service Area. (USFWS NWI, 2015)

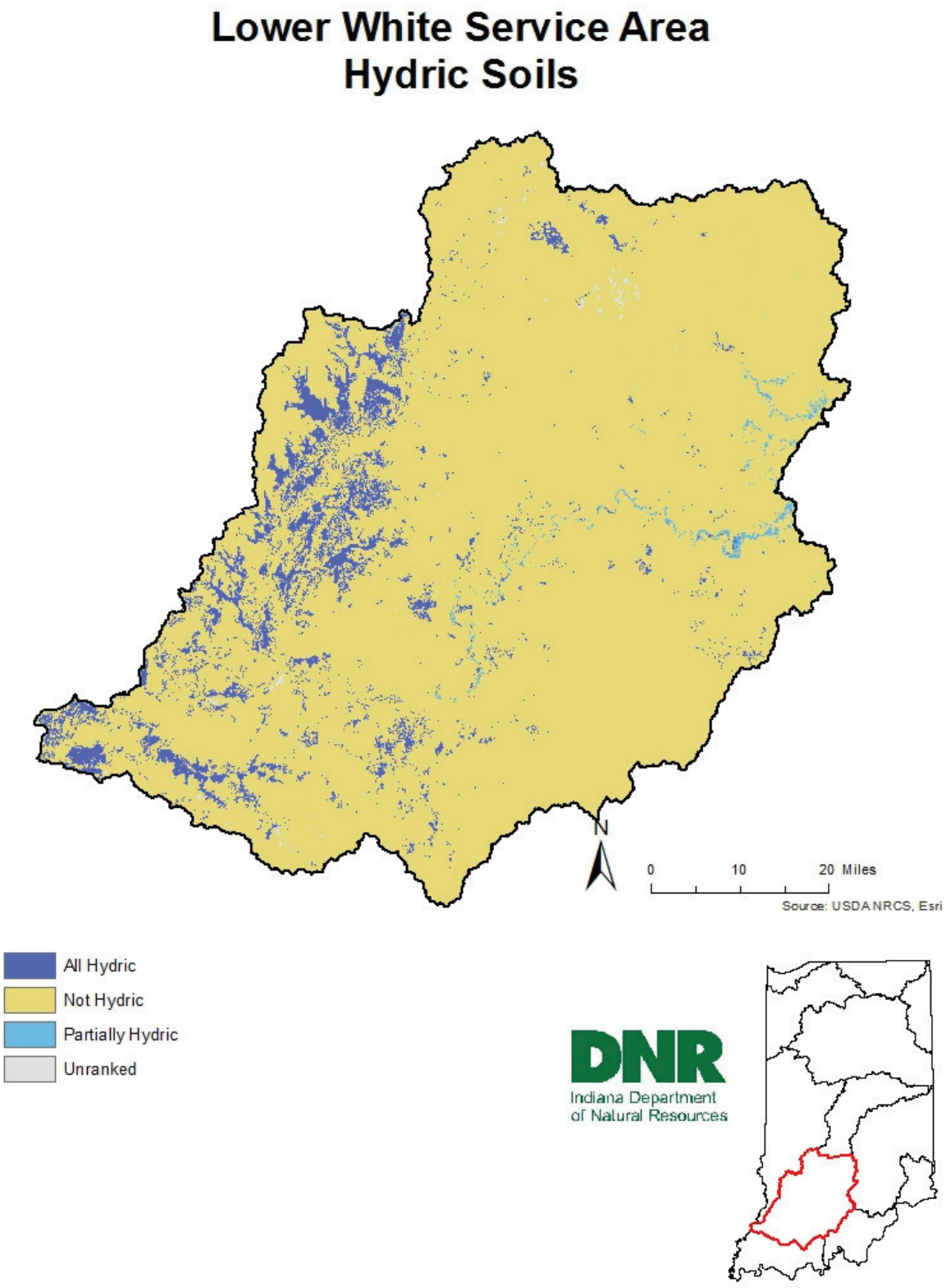

Figure 112. Hydric and partially hydric soils within the Lower White service area (NRCS-USDA, 2016)

4.3 Concentrations of Potentially Restorable Wetlands and Streams

GIS hotspot analysis was conducted to document concentrations of the identified potentially restorable wetlands and streams. Hotspots account for 90,655 acres of potentially restorable wetlands within the SA. The watershed with the most hotspots of potentially restorable wetlands is Killion Canal-Prairie Creek (HUC 051202020707 **[Table 96]**).

Hotspots account for 2,882,880 linear feet of potentially restorable streams within the SA. The watershed with the most hotspots of potentially restorable streams is Kane Ditch-Smothers Creek (HUC 051202020507 **[Table 97]**).The watersheds with the highest concentrations of potentially restorable wetland and streams **(Tables 96 & 97)** serve as the basis of identification of areas that have experienced the most recoverable aquatic resource loss within the SA and are shown in **Figure 97**.

Approximately 5,459 acres of these hotspots of potentially restorable wetlands are on IDNR-managed lands within the Lower White SA. Goose Pond Fish and Wildlife Area is the IDNR-managed land in the Lower White SA with the most adjacent hotspots of potentially restorable wetlands (3,141 acres). Other IDNR-managed lands in the Lower White SA with adjacent acres of hotspots of potentially restorable wetlands are White River Bend Wildlife Management Area and Greene-Sullivan State Forest. Approximately 33,524 linear feet of hotspots of potentially restorable streams are adjacent to IDNR-managed lands. Goose Pond Fish and Wildlife Area is the IDNR-managed land with the most adjacent hotspots of potentially restorable streams (19,644 linear feet).

HUC 12 Code	HUC 12 Name	Hotspots of Potentially Restorable Wetlands (acres)
051202020707	Killion Canal-Prairie Creek	8,283
051202090505	Fourmile Creek	7,279
051202020507	Kane Ditch-Smothers Creek	6,960
051202021005	Upper River DeShee	5,806
051202021005	Claypole Pond-White River	5,732

Table 96. Watersheds in the Lower White Service Area with the most hotspots of potentially restorable wetlands

HUC 12 Code	HUC 12 Name	Hotspots of Potentially Restorable Streams (linear feet)
051202020507	Kane Ditch-Smothers Creek	159,456
051202021005	Upper River DeShee	155,232
051202020707	Killion Canal-Prairie Creek	121,968
051202090505	Bruner Creek	103,016
051202090302	Fourmile Creek	102,432

Table 97. Watersheds in the Lower White Service Area with the most hotspots of potentially restorable streams

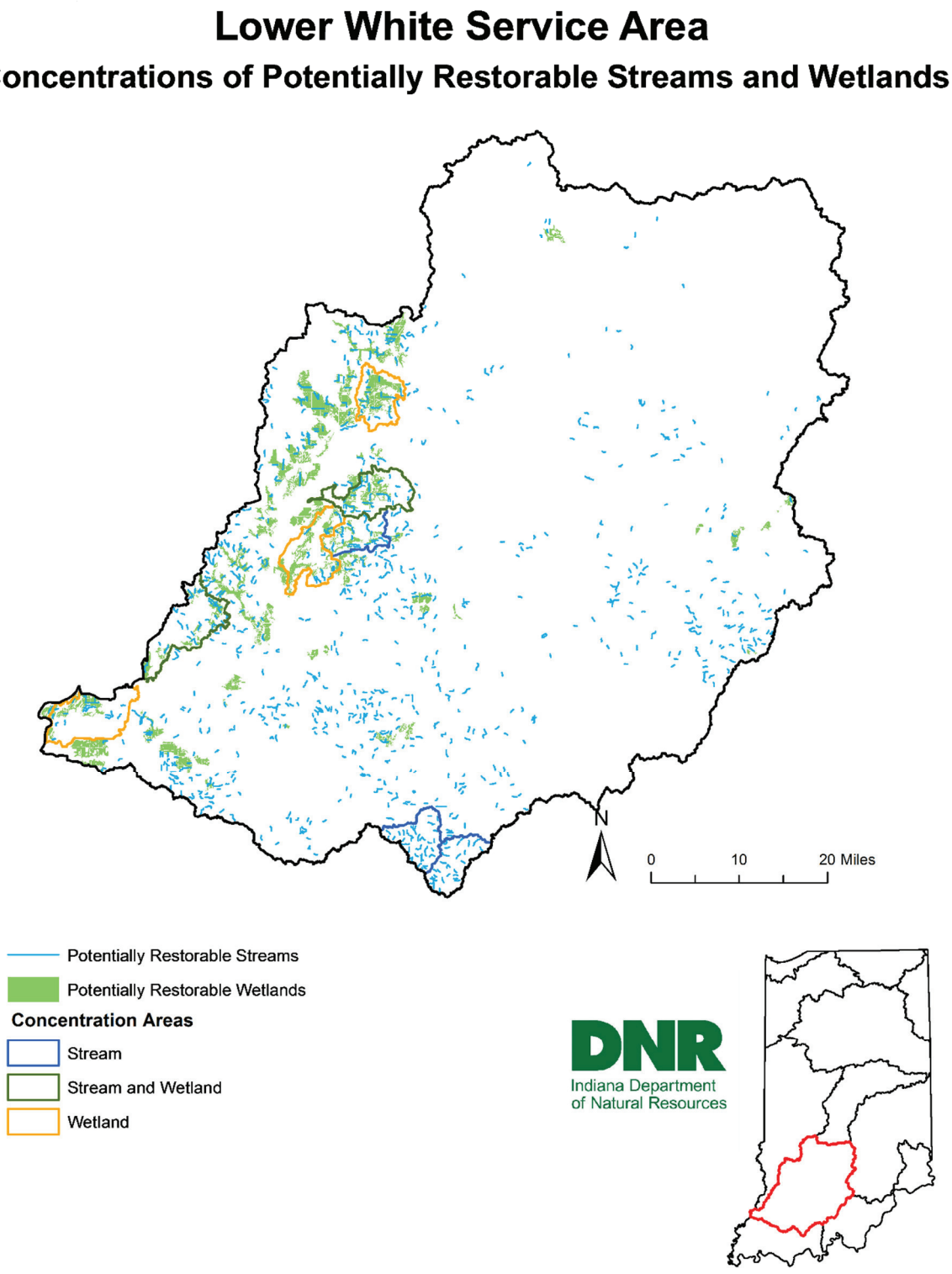

Figure 97. Concentrations of Potentially Restorable Streams and Wetlands in the Lower White Service Area

4.4 Lakes, Reservoirs and Ponds

GIS analysis of 303(d) lake impairments (IDEM-IR, 2016) in the Lower White SA identifies five lakes currently documented with category 5 impairments, which measured using the National Hydrography Dataset (NHD) accounts for approximately 6,969 acres with algae, 3,887 acres for taste and odor, 114 acres of total mercury in fish tissue, and 100 acres with E. coli (IDEM-IR, 2016).

The 2011 NLCD identifies approximately 53,096 acres of open water which accounts for 1.82% of the SA. This varies slightly from the NWI, which identifies approximately 25,542 acres of freshwater ponds comprising of 0.9% of the SA, and 30,544 acres of lake comprising of 1.1% of total SA acres. There are no PFL's (IC 14-26-2-1.5) located within the Middle Wabash SA. IDNR will remain up to date with reservoir (lake) condition data from sources such as IDEM, the Indiana Clean Lakes Program, watershed management plans, lake associations and the like as the landscape watershed approach is utilized to identify aquatic resource needs within the SA.

4.5 Ground Water and Surface Water Interaction

The data presented in this section will help identify potential areas in need of increased ground water recharge and/or identifying sensitive aquifers in need of increased buffering and protection from potential contamination threats.

Analysis of the near surface aquifer recharge rate data from IGS (Letsinger S. L., 2015) for the Lower White SA shows that nearly 100% of the shallow unconsolidated aquifers receive between seven or less inches of ground water recharge annually **(Table 98).**

Recharge Rate	Inches/Year	Square Miles	Percent of Calumet-Dunes SA
High	14	0	0.00%
	13	0	0.00%
	12	0	0.00%
	11	0.01	0.0002%
	10	0.4	0.01%
	9	1	0.01%
	8	27	0.59%
	7	166	3.65%
	6	552	12.10%
	5	1,150	25.21%
	4	1,085	23.78%
	3	992	21.74%
Low	2	384	8.42%
	1	205	4.49%

Table 98. Approximate ground water recharge rates in the Lower White Service Area (Letsinger S. L., 2015)

Analysis of the IGS near surface aquifer sensitivity mapping (Letsinger S. , 2015) indicates that nearly 100% of the Lower White SA's near surface aquifers are in the low to high range for sensitivity to

contamination with approximately 85% being moderate to low **(Table 99)**. The aquifer sensitivity reflects the middle to lower range of aquifer recharge rates. The near surface aquifer sensitivity mapping shows that aquifers with high sensitivity are generally confined along the major river corridors within the SA.

Sensitivity	Square Miles	Percent of Total Acre
Very High	0.5	0.01%
High	658	14%
Moderate	1,964	43%
Low	1,901	42%
Very Low	40	0.88%

Table 99. Ground water sensitivity distribution in the Lower White Service Area (Letsinger S. , 2015)

Analysis of the IDNR Division of Water's Water Rights Section 2015 significant water withdrawal facilities data shows the Lower White SA is fifth among SA's for registered capacity of surface water withdrawal with a 2015 withdrawal capacity of 152,238 MGD **(Figure 113)** (IDNR DOW, 2016). Energy production accounts for approximately 91% of registered withdrawal capacity and public water supply at 7%.

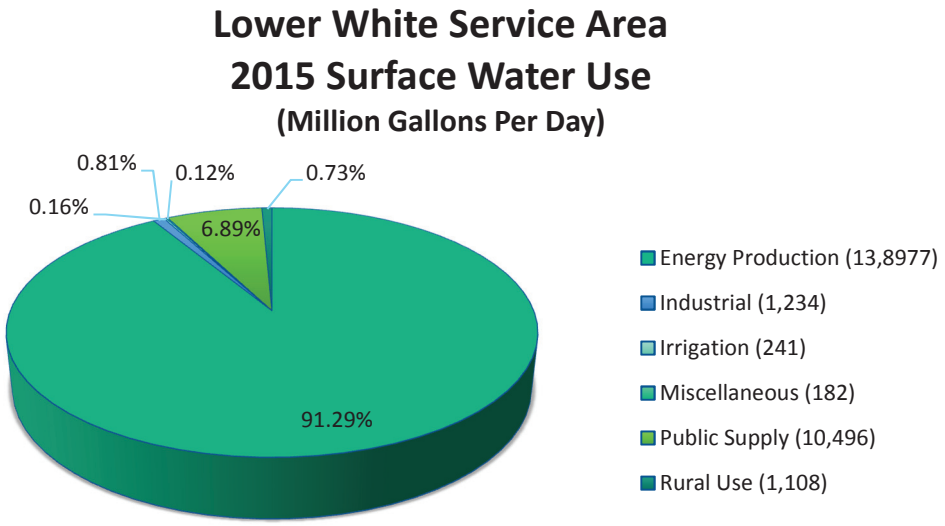

Figure 113. 2015 surface water usage in the Lower White Service Area (IDNR DOW, 2016)

Significant ground water withdrawal in the Lower White SA is the fourth least of any SA with a 10,571 MGD registered capacity **(Figure 114).** Public water supply accounts for approximately 47% of registered ground water withdrawal capacity in the SA, followed by energy production and mining with 38%, and industrial use with 12%.

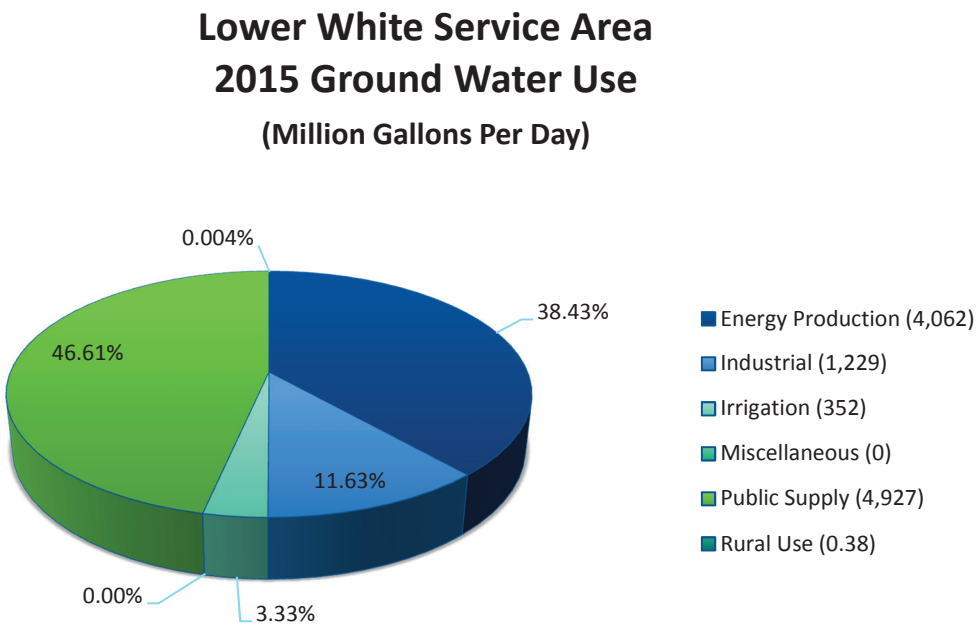

Figure 114. 2015 ground water usage in the Lower White Service Area (IDNR DOW, 2016)

4.6 High Quality Aquatic Resources and Natural Communities

In addition to previous eco and natural region descriptions of this SA, other high quality natural communities currently documented in the Natural Heritage Database located within the Lower White SA include, but are not limited to, aquatic cave, acid seep, circumneutral seep, forested swamp, shrub swamp, sinkhole swamp, and wet floodplain forest, in addition to many other transitional, mixed and upland communities.

There are currently a minimum of seven amphibian species, 47 bird species, seven fish species, 14 mammal species, 15 mollusk species, and seven reptile species listed as SGCN within the SWAP Planning Regions within the Lower White SA (SWAP, 2015).

ELEMENT 5. AQUATIC RESOURCE GOALS AND OBJECTIVES

Aquatic resource goals and objectives identified in the statewide CPF also apply to the Lower White SA. The following aquatic resource goals and objectives apply specifically to the Lower White SA based on 404 permitted impact trends, predominant threats, historic loss, current impaired and high quality aquatic resource conditions, habitats and SGCN, and current and future priority conservation areas. The general amounts of aquatic resources IDNR will seek to provide will depend on ILF credit demand.

1. Restoration, enhancement and preservation of aquatic resources that will offset current and anticipated threats within the SA.
2. Implement natural stream channel restorations in order to help offset chemical, physical and biological impairments and degradation resulting from anthropogenic activities to include

considerations such as in-stream habitat, physical integrity, riparian cover, and/or potential removal or modification of dams.
3. Re-establishment of historic aquatic resources that have experienced high concentrations of loss, fragmentation and/or impairment, such as the identified concentrations of potentially restorable streams and wetlands to include any channel restoration needs.
4. Implement projects within and adjacent to current and future areas identified as conservation priorities by federal, state and local government entities, and non-governmental organizations (stakeholder involvement/conservation partnerships).
5. Preservation of rare and high quality aquatic resources; critical habitat for rare and endangered species; priority habitat for species of greatest conservation concern; and/or other areas meeting the requirements of 33 CFR §332.3(h).
6. Support critical habitat restoration for federal and state listed SGCN within and adjacent to aquatic resources while applying the SWAP identified conservation needs and actions in the Interior Plateau, and Interior River Valleys and Hills Planning Regions where feasible.
7. Stream and wetland restoration projects to buffer and protect karst features and systems unique to areas in southern Indiana.
8. Support efforts to offset aquatic resource degradation associated with historic mining activities throughout the service area.

ELEMENT 6. PRIORITIZATION STRATEGY

The four steps below present the prioritization criteria for mitigation site identification and selection. This prioritization strategy will be used for project selection within each SA. When prioritizing sites for mitigation projects, the following **core criteria** shall be utilized.

1. Mitigation site proposals must contain the ability to result in a successful and sustainable net gain and/or preservation of aquatic resource functions and services and/or result in no net loss of Indiana's aquatic resources.
2. Prioritization will be given to compensatory mitigation projects that provide the greatest benefit to the Lower White SA, by providing the greatest lift in aquatic resource functions and services based upon the specific needs identified within the SA and/or watershed utilizing the watershed approach for site selection.
3. Project proposals will consider how to offset the anthropogenic threats to aquatic resources, historic loss, and existing and future impairments while achieving IN SWMP goals and objectives, within the SA.
4. Other prioritization evaluation criteria may include, but are not limited to; cost, feasibility, size, proximity to other conservation lands or protected areas, connectivity or location with respect to corridors, human use value, and efficient long term maintenance.

In addition to the Core Criteria, information from conservation partners, landowners and additional stakeholders may also be utilized during the site selection process as they may have additional data or a pre-existing list of priority restoration projects. Ground investigations will be required to confirm or dismiss these datasets and determine the best locations for compensatory mitigation project sites.

Currently, the following watershed plans exist within the SA: Beanblossom Creek WMP, Kessinger Ditch WMP, Lost River WMP, Lower Patoka River WMP, Middle Patoka River Watershed Source Water Protection Plan, North Fork Salt Creek/Sweetwater Creek WMP, Owen County Watershed Initiative WMP, Patoka Lake Source Water Protection WMP, Patoka River (upper) WMP, Prairie Creek WMP, and Yellowwood Lake WMP. However, IDNR will utilize the most current watershed planning information that is available as these plans are updated and/or new watershed plans are developed within this SA over the life of the program.

ELEMENT 7. PRESERVATION OBJECTIVES

When applicable under 33 CFR §332.3(h) of the Federal Mitigation Rule, preservation objectives within the Lower White SA will include rare and high quality natural aquatic and riparian communities, waters having a significant contribution to ecological sustainability, as well as important habitat for SGCN while addressing the important physical, chemical, or biological functions provided to the watershed that address critical conservation needs throughout the service area. Additionally, there will likely be aquatic resource and habitat preservation and/or enhancement opportunities in conjunction with the primary objective of restoration to be determined on a per project basis and approved by the Corps/IRT.

ELEMENT 8. PUBLIC AND PRIVATE STAKEHOLDER INVOLVEMENT

Currently, the following land trusts exist within the SA: Ouabache Land Conservancy, Four Rivers RC&D, Oak Heritage Conservancy, Indiana Karst Conservancy, and Sycamore Land Trust. There is the potential for land trusts to dissolve, adjust their geographical boundaries, and for new land trust organizations to be created within the SA. IDNR will work with the land trusts that exist in the SA over the life of the program

Additional stakeholders' interest and potential conservation partnerships specific to the Lower White SA, and in which IDNR is an interested party include, but are not limited to the following organizations and/or initiatives:

- USGS Indiana Water Science Center
- USGS Illinois Water Science Center
- U.S. Forest Service Hoosier: National Service and Charles C. Deam Wilderness
- Eastern Tallgrass Prairie and Big Rivers, and Appalachian Landscape Conservation Cooperatives
- Municipal Separate Storm Sewer Systems (MS4) Communities
- Municipal and County governmental entities
- Active Watershed Groups and appropriate Watershed Management Plans
- Southern Indiana Development Commission
- West Central Indiana Economic Development District
- Economic Development Coalition of Southwest Indiana
- Indiana 15 Regional Planning Commission

- River Hills Economic Development District and Regional Planning Commission
- Friends of Goose Pond
- Friends of the White River
- Indiana Karst Conservancy
- Oak Heritage Conservancy
- Mississippi River Basin Initiative

Currently known public, private and non-profit conservation priority areas as identified by the 2015 IWPP (IWPP, 2015) are shown in **Figure 115** below.

ELEMENT 9. LONG TERM PROTECTION AND MANAGEMENT

Long term protection and management strategies will be conducted in the same manner per SA as outlined in the statewide CPF.

ELEMENT 10. PERIODIC EVALUATION AND REPORTING

Periodic evaluation and reporting on the progress of IN SWMP will be conducted in the same manner per SA as outlined in the statewide CPF.

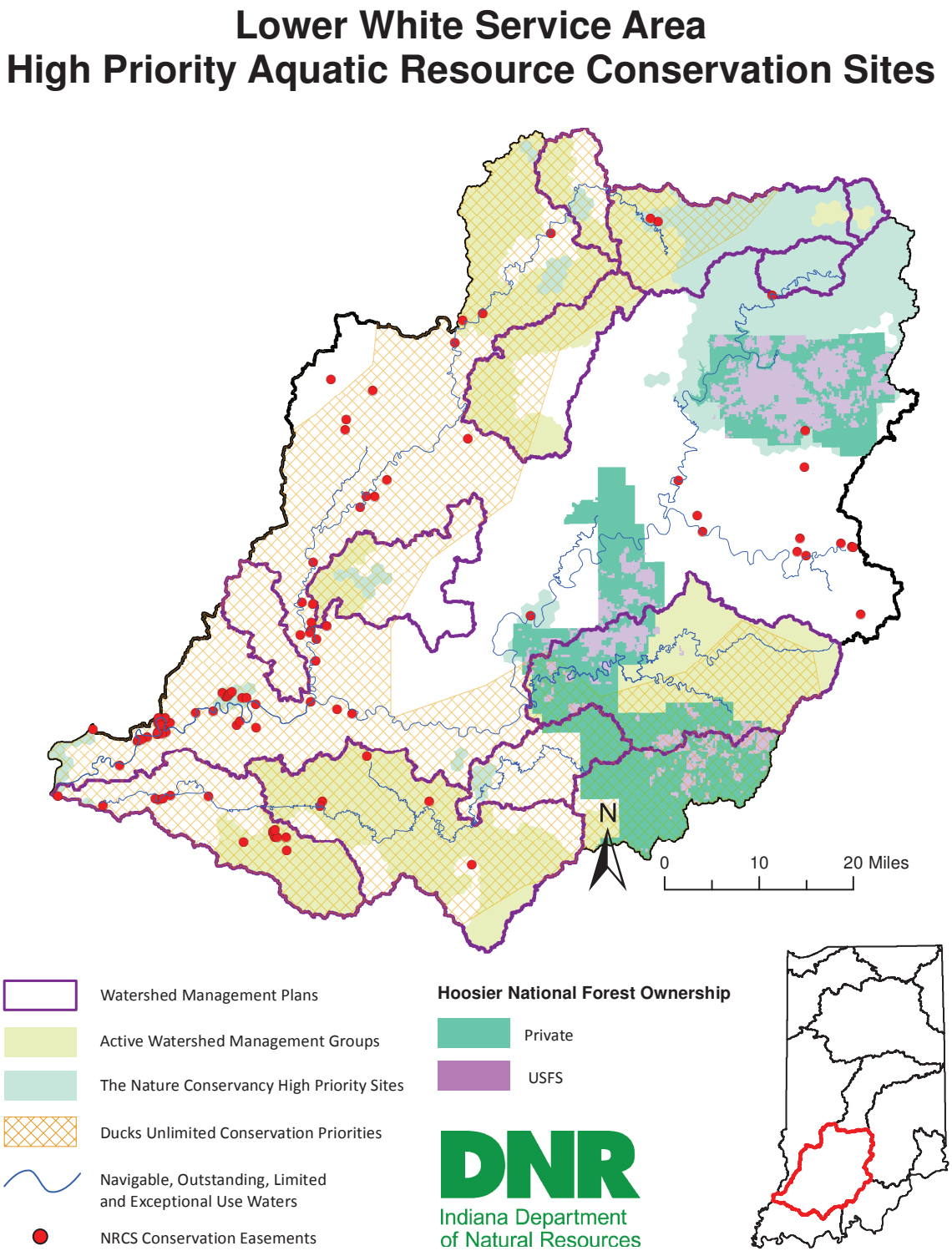

Figure 115. Priority aquatic resource conservation groups and sites within the Lower White Service Area (IWPP, 2015)